The Science Teacher

DECEMBER
1939
Volume VI
Number 4

Copyrighted by
The Science Teacher

Published
Quarterly
October
December
February
April

(See Page 4) Courtesy Scopes Club

A National Service Journal

NOW *A Nine-Year Science Program*

Three separate, self-sustaining, carefully graded science series bound together by a common plan of science teaching. They present science as—

A way of working and thinking
A broad field of study
An attitude

SCIENCE STORIES
Beauchamp-Fogg-Crampton-Gray

DISCOVERING OUR WORLD
Beauchamp-Melrose-Blough

SCIENCE PROBLEMS
Beauchamp-Mayfield-West

SCOTT, FORESMAN AND COMPANY

CHICAGO ATLANTA DALLAS NEW YORK

WELCH

No. 3031-C

Cadet Portable Meters

D. C. and A. C. at Low Prices

Voltmeters, Millivoltmeters, Ammeters and Milliameters—in SINGLE, DOUBLE AND TRIPLE SCALE INSTRUMENTS.

THREE-INCH DIAL.

JEWEL BEARING MOVEMENT.

GUARANTEED ACCURACY TWO PER CENT OF FULL SCALE.

SPECIAL FEATURE—For instant differentiation—**A.C. Meters housed in red mahogany bakelite case; D.C. Meters in mottled green bakelite case; and galvanometers in a black bakelite case.**

Write for Complete Circular Giving Ranges and Prices.

W. M. WELCH SCIENTIFIC COMPANY

1515 Sedgwick St. Established 1880 Chicago, Ill.

The Science Teacher

Copyright, 1939, by The Science Teacher

VOLUME VI DECEMBER, 1939 NUMBER 4

Some Common Chicken Lice and Mites

LEE H. TOWNSEND

University of Kentucky Lexington, Kentucky

This article is the second of a series in the field of economic entomology presented to help the teacher relate biology more closely to the student's environment.—The Editor.

WE ARE APT, for some reason, to estimate value by size and to hold small things in contempt. Though we should have learned full well from science that the smallest of living creatures may be very important to our welfare, we often persist in belittling such a study.

The microscope has made the smallest insect as easily studied as the dog and on the printed page an equal number of words may be required for the description of both.

The animals with which we are concerned in this article are small but no less interesting than the larger ones. To see them distinctly and to study them a magnifying glass is necessary. This need not be of high power but it should magnify at least seven or eight times.

Domestic fowls — hens, geese, ducks, turkeys, guinea fowls, etc. — constitute one of the most important sources of the American food supply. The value of eggs and chickens produced each year is very great. It is thus evident that any pests seriously affecting poultry should be carefully considered.

Among the external poultry parasites which are probably of most importance in the United States are several different kinds, or species, of lice and mites.

TEACHERS OF biology might wonder just how such a subject as this could possibly be of interest and use to them. There is nothing which the biology student appreciates more than being shown the things under discussion. With some effort and under proper guidance those who are interested can secure examples of lice and mites. These are available during almost the entire year, and furnish opportunity to introduce the study of parasites. There are represented here two kinds of parasites, those which spend their entire life on the body of the animal from which they derive their living, and those which seek out the animal only when they desire to feed. This animal which furnishes food and a place to live is called the host. Mites have been shown to be capable to transmitting disease from sick to healthy fowls. The English sparrow may carry lice and mites from place to place. Surely all of these reasons are enough to make such a study appealing and worthwhile.

The bird lice (Order Mallophaga) are wingless, parasitic insects and occur throughout the world. The mouth parts, which are formed for chewing, are situated on the under or ventral side of the head. The most active parts in chewing are two large, strong mandibles which are more or less triangular in shape. Other mouth parts are generally present but may be poorly developed.

The head is comparatively large and variously shaped. In many of the common species it is cut out behind and sits on the next portion of the body like a hat. The antennae or feelers are always short and are composed of three, four, or five segments. They may differ in the two sexes of the same species of louse. The eyes are two in number and often very dark in color. The legs of bird lice are usually stout, conspicuous and bear two sharp claws at the tip.

AS ALREADY stated, these lice have chewing mouth parts, and do not suck the blood of their hosts. It is doubtful whether any of the lice parasitic on domestic fowls ever get any blood except in case of a wound from which blood may issue, then the parasites may eat the dried scales of blood. It has been observed that the head-louse of the hen will feed on dried blood, and that the body louse of the hen may sometimes bite into the soft, live, feather-quills and feed on the fresh blood. No definite facts are at hand concerning the extent or seriousness of this injury to domestic fowls.

It is generally conceded that poultry lice feed on portions of the feathers or on scales from the skin. and their presence in any considerable numbers is responsible for injury, the constant chewing at the skin causing serious irritation. Some writers claim that the persistent movements of the sharp claws of the lice also add to the injury and discomfort.

The first signs of lice infestation usually are droopiness, lowered wings, and ruffled feathers. If the lice are abundant, growth of the young chicks may be checked, diarrhea usually follows, and a general weakened condition may result. Egg production is affected and the fowls are more apt to succumb to common diseases. The loss caused by these lice is difficult to estimate.

Chickens are infested by seven species of lice, more than are found on any other domestic fowl. Turkeys, ducks, and geese have their own special kinds of lice.

The seven different kinds of lice common on hens are spoken of as body lice, head lice, and feather lice, according to the place in which they are usually found. The species tend to intermingle to a considerable extent so it it not possible to separate them absolutely on this basis. Usually three or more species are to be found on an infested fowl, but seldom all seven.

SPACE DOES NOT permit us to consider all of these species, but for the sake of illustration we shall briefly discuss the life history of two of them.

The common name "body louse" as used for one species (Eomenacanthus stramineus Nitz) refers to its habits of remaining on the skin of the fowl rather than on the feathers. It may sometimes be taken on the head, neck, and legs, not always confining itself to the body.

This louse is rather large, usually about 1-10 inch in length, but may be slightly longer. It is robust, straw yellow in color, with some dark spots due to feed within the digestive tract. The male is not so slender as the female.

This species is probably the most injurious one on grown fowls, but sometimes also seriously infests young chickens. Irritation is kept up constantly, since it remains on the skin of the host.

The eggs are deposited on the bases of the feathers. They are usually attached in clusters which may sometimes become very large, perhaps half an inch in length.

The eggs hatch in about a week and the adult stage is reached in 17 to 20 days after the eggs are deposited. In summer the period of growth is shorter than in winter because of the higher temperature. The heat of the body is necessary for the hatching of the eggs, and the lice themselves cannot live except on the fowl.

The body louse seems to pass easily from one fowl to another when two are in contact. Young chickens which have just hatched may be infested from the hen before they leave the nest. Uninfested fowls brought into an infested flock may pick up the pests by mixing and by touching on the roost.

THE HEAD LOUSE is occasionally found on the neck and elsewhere, though primarily a head louse. It is without doubt the most injurious species (Lipeurus heterographus Nitz) to young chickens. Many of the other forms are annoying to grown poultry but do not thrive well in the down on chicks. It is dark gray and nearly as large as the body louse, and may be found on the top or back of the head or beneath the bill. Usually located with its head very close to or against the skin. The eggs are deposited singly on the small feathers, or down, about the head. These

hatch in 4 or 5 days into minute young which resemble the adult in shape. As the lice grow they become darker in color, and reach the adult stage in 17 to 20 days. This species passes readily from one chicken to another and the mother may infest her young.

These two short discussions illustrate the typical development of poultry lice and we will not consider other species. The time necessary for development may vary but the general life cycle of all species is the same. Development continues throughout the year but is of course much slower during the winter months.

Poultry lice have been generally considered as a more or less necessary evil and the best that can be done is to fight them almost continually. A flock can be entirely freed from lice and maintained thus if those responsible so desire.

It should be evident from the life habits of lice that one way to control them is to apply some substance directly to the body of the fowl. In addition, it should be kept in mind that cleanliness, plenty of fresh air and light, a good supply of drinking water, and clean dust baths are important in keeping these parasites under control.

SODIUM FLUORIDE has been found to be a satisfactory material for controlling poultry lice. It is poisonous to all species of chicken lice, killing both adults and young. It does not prevent the eggs from hatching, but the newly hatched young are killed by the material remaining in the feathers for several days.

Sodium fluoride is a white powder and can be obtained from dealers in poultry supplies as well as druggists. In a dry state it will remain active indefinitely and should be kept either in bottles with stoppers or in closely covered cans.

IN TREATING poultry with sodium fluoride the material may be applied in two forms — as a dust or as a dip.

Dusting: The so-called "pinch method" is effective against all lice. (7) "It is best to lay the fowl over a shallow pan or paper on a table. A "pinch" of the powder is sifted among the feathers next to the skin or the head, another on the neck, two on the back, one on the breast, one below the vent, one on the tail, one on each thigh and one on the underside of each wing."

Dipping: In using the dipping method, measure warm water into a tub and add one ounce of sodium fluoride for each gallon of water. It dissolves at once when stirred. (7) "Hold the fowl by both wings with one hand, lower it into the water and ruffle the feathers for about ½ minute until they are soaked to the skin; then duck the head under twice, and the fowl is ready to release."

The lice die much more quickly following dipping than when the material is used as a dust. Sodium fluoride is poisonous to man and thus should not be left where it might be used as food or medicine by mistake.

SINCE 1928, nicotine sulphate has been widely used against chicken lice. At that time it was discovered by a poultryman in California that this material applied to the roosts would kill large numbers of lice. The method consists in applying a line of nicotine sulphate along the top of all roosts or perch poles about half an hour before the fowls go to roost. It may be put on with an oil can, small paint brush, or from the nicotine sulphate bottle when it is provided with a perforated top through which the material can be spread. A thin continuous strip ½ inch wide is sufficient. When the fowls go to roost the nicotine sulphate fumes pass upward through the feathers and kill the lice. Very soon these drop from the host. Most of the lice are killed the first night after treatment though the effects are felt slightly the second and third nights. This treatment must be repeated 8 to 14 days later to destroy lice hatching from eggs present the first time. Some head lice and wing lice are likely to escape being killed, so complete eradication could hardly be expected from this method, while it is possible to entirely clean fowls of lice with a single thorough treatment of sodium fluoride.

(Continued on page 24)

THE SCIENCE TEACHER

201 North School Street, Normal, Illinois

A National Journal Serving State and Regional Associations

John C. Chiddix..Editor-in-Chief and Business Manager
S. A. Chester....Assistant Business Manager
Joseph Singerman....Eastern Advertising Manager
Christopher Columbus High School, New York City
R. U. Gooding....Service Extension
Illinois State Normal University, Normal, Illinois

DEPARTMENTAL EDITORS

Karl F. Oerlein....Science Clubs
State Teachers College, California, Pennsylvania
Joseph Singerman....Science and Society
Christopher Columbus High School, New York City
Philip B. Sharpe....Abstracts
Greenwich High School, Greenwich, New York
P. K. Houdek....Illinois Biology Editor
Robinson Township High School, Robinson, Illinois
Allan R. Stacy....Indiana Chemistry Editor
Washington High School, Indianapolis, Indiana

CONTRIBUTING EDITORS

Charles R. Naeser....George Washington University
Washington, D. C.
John C. Hessler....James Millikin University
Decatur, Illinois
Greta Oppe....Ball High School, Galveston, Texas
R. M. Parr....University of Illinois, Urbana, Illinois
C. B. Read....University of Wichita, Wichita, Kansas
W. Roland Galvin....Thomas Jefferson High School
Richmond, Virginia

DIRECTORS
Advisory Board

Douglas G. Nicholson....Editorial
University of Illinois, Urbana, Illinois
Nicholas D. Cheronis....Service
Wright Junior College, Chicago, Illinois
Carrol C. Hall....Circulation
Springfield High School, Springfield, Illinois

Subscription rates: In the United States, $1.00 per year, or $1.75 for two years; in Canada, $1.25 per year, or $2.00 for two years. THE SCIENCE TEACHER is published quarterly during the school year.

HEALTH EDUCATION PROGRAM

Beginning with the next issue a series of articles will be started dealing with health education and its place in the biology course. If biology is to be closely related to the individual and his environment, there certainly can be no better way than to study it in relation to the proper functioning of the human body and protection from disease. When approached from this angle biology becomes a truly functional subject.

The first two articles of the series will deal with new trends in health education and will include aspects of the functional health program in the high school and the school health examination as a keystone of the school health program. The remaining seven articles deal with significant health considerations of the high school group. They will include what high school students should understand about communicable diseases; nutrition for normal growth and development; rest and recreation as health factors; eye health; social hygiene; mental hygiene; and measuring the functional value of the school health program.

A group of outstanding leaders in the field of health education have been secured to present the health program. They will be announced in the coming issue.

CO-OPERATIVE WORK

If you are interested in working with other teachers in providing useful services in the science field, write to us stating your interest.

Those who know of sources of free exhibit materials or booklets should write directly to Walter E. Hauswald, chairman of this group, at Sycamore High School, Sycamore, Illinois. He would appreciate your help.

OUR FRONTISPIECE

The picture on the cover shows part of the Scopes Club of the Taylor Allerdice High School, Pittsburg, Pennsylvania, at work. The projection screen in the background was made as a project.

Accessible Enrichening Materials

EDITORIAL

ENRICHENING materials for the high school science course may make the difference between outstanding success and very mediocre teaching. They often breach the gap between the theoretical and the practical — creating student interest, provoking thought, and promoting student achievement. Science in the high school can no longer be barren of contact with the local environment, including such phases of it as food, clothing, shelter, transportation facilities and the requirements for entertainment and amusement. Should the course not be functional in the lives of students, it will be avoided, if elective. Should it be compulsory (it is hoped this does not occur), then the reaction of students will be most unfavorable to the teacher, especially if other teachers in the same school system are alive to present-day needs.

The problem of the teacher is to make such close contact between the theory and facts of science and the every day life of the individual that the subject is alive and full of interest. The subject matter may include, for example, such features as the study of fuel burned in the home, care of the pets, efficiency of the carpet sweeper, and comparative value of soaps being used. The theories and facts of science then become functional in terms of practical applications and problems.

FURTHER HELP beyond that of the text is necessary to enable the teacher to make the most of the local situation. If a study of food is in progress, then information in the field of consumer buying may be needed to get the most for the amount spent. The quality of different brands of some canned foods, for example, may need to be compared, the bacterial count in milk determined, proper insulation and lighting of a home appreciated. With all these problems information is needed to enable the students to make an intelligent study and arrive at satisfactory conclusions

Additional reading may be needed to understand many problems for which there is not adequate space available in the text book. Inspirational reading may be needed for many students to give added satisfaction in the field of science; the challenge of outstanding achievements are always wholesome for any group.

SCIENCE BOOKS and magazines are rich in materials for any science course of the high school level and should be used to supplement the work. The chief difficulty for the busy teacher is knowing what is the most desirable references for his purpose and which are the best suited to the individuals doing the reading.

Help for the teacher in the form of an analytical reference list is likely the best solution to the problem. It is true that reference lists are available, but assignments made from them are often disappointing to the teacher and discouraging to the student because the reference was not adapted to the ability or needs of the student. Then sometimes reference lists are made up of material that has only been casually examined rather than from material that has proved to be good in actual use.

A reference list would be far more useful if it gave some indication as to quality of the article, its value—whether for motivation, remedial work, or subject matter, the style in which it is written, its difficulty — whether easily read or suited to the more capable student, and also its nature as to whether it is expansive or intensive in treatment.

OBVIOUSLY, reference lists of this type can be compiled best through the co-operative efforts of a number of teachers. A group is already at work in the fields of biology and chemistry. However, other workers are needed. Those interested should write the editor of this journal or Dr. Nicholas D. Cheronis of Wright Junior College of Chicago, who is directing this service work for science teachers.

—JOHN C. CHIDDIX.

Why Teach Chemistry in the High School?

J. H. RANSOM

James Millikin University — Decatur, Illinois

IN DISCUSSING the question of why chemistry should be taught in the high school, it is not assumed that every high school student should take a course in chemistry, although it is thought such a course would broaden the outlook of the student mind, and would lead to a more thorough and satisfying understanding of many of the common phenomena of life. This would be true, especially for those students whose mental aptitude, and consequent main interest, lies along other than scientific lines. At any rate the world of knowledge has become so large and complex that no one can hope to envision it, or comprehend more than a small sector of it. Consequently, a choice must be made.

What choice shall be made and what range of subjects is desirable must depend to some extent on one's philosophy of education. If education is simply a method of developing in the mind an attitude towards life; if its end is to acquire that indefinite though very desirable quality of heart and mind called culture, then the range of one's studies may be of less consequence than the particular courses of study and the length of time devoted to their study. There can be no question but that more or less culture results from prolonged study of the classics, of history, of literature or of the social sciences, and that it was thus secured before chemistry and other pure sciences became an integral part of the curricula of high schools and colleges. But in the thought of the writer, culture is a by-product of education; to some extent of any education, whether it be formal or incidental, elementary or comprehensive, classic or scientific, the important condition being that the subjects be taught in a manner to lead to clear thought and fundamental knowledge. Most certainly chemistry may claim a place in this method of study, and even the mechanic arts need not be excluded.

IT MUST BE recognized, however, that culture, like education, is individual and may not be acquired in equal degree irrespective of time and effort expended upon it. Education, with its accompanying culture, is, in part, to use a chemical figure, a searching out of the characteristic properties of the individual. The ideal in education is properly to relate the man to his inborn ability or power. It is designed to fit him to do his part, however small or great it may be, in the work of the world, and to do it well.

If chemistry does have in it the power to stimulate the individual to the highest of which he is capable then, in common with other courses of study, it has a place in education and deserves a place in the curriculum of the high school; for in addition to this service it may furnish a satisfactory and practical method of livelihood for people with certain individualities.

THAT THE STUDY of chemistry does have stimulating power is recognized by the students who have had high school chemistry. This was shown by the reaction of a class of more than fifty freshman college students who near the end of their school year were asked to spend five minutes in writing down one or more reasons for or against teaching chemistry in the high schools. Fifty-one favored it while three were against it. It is difficult to classify the reasons given, but roughly they may be grouped as follows:

Chemistry is practical for those not going to college	15
Chemistry gives a better understanding of the world	12
Chemistry teaches fundamentals and how to think	12
Chemistry gives increased general knowledge	9
Chemistry serves as a foundation for advanced work	2

Some students gave more than one reason, as indicated in the following quotation: "High school chemistry prepares the student that is going to college with a better knowledge. It is a subject of thinking; makes for better understanding; gives you ideas with which to think, and is helpful in everyday usage." "If science isn't your favorite field it is always a good idea to take it anyway." "You can't lose by it, for it gives you a background for more advanced courses in college." One student went so far as to say that chemistry should be required of every high school student.

From the replies received from this representative class it is quite evident that the students recognize the value that chemistry has been to them as a source of knowledge and of mental development as well as a foundation for further study. And it is quite evident that its study had a stimulating effect on their minds. This interest in chemistry and its stimulating effect are but natural and almost necessary, for young people are living in an atmosphere of chemistry. It is in the home, the shop, the factory and the store; in the paint they use, the automobiles they drive, the moving picture films they see, the water they drink, and in the food they eat. In almost every daily paper and magazine some phase of chemistry is mentioned or discussed and so becomes a topic of home discussion and explanation. Why not give students an opportunity to become familiar with its fundamentals and basic concepts at an early age while curiosity and inquiry are still a prominent characteristic of the mind?

A DEFENSE for teaching chemistry in high school is found, also, in the more natural approach it gives to the study of subject matter related to one's environment. In the elementary grades and quite largely in the high schools the learning process is almost wholly from assigned lessons found in a text book. Quotation from the text becomes a habit until the meanings of the words and the thought contained in the sentences are lost in the forms committed. So much is this so that college students are criticised for not being able to read, that is, are not able quickly to glean the meaning from the printed page. It is true that chemistry also uses the text book, and this method has its place in all education, however advanced. But chemistry makes side excursions by way of experiment, thus enabling students to find many facts which otherwise they would take from the books. This method of approach causes the students to study the text from a different angle, and it also arouses his curiosity and his desire to do things and to find out facts for himself.

THAT YOUNG people like to experiment and (to them) discover facts is shown by the popularity of chem-kits; of mechanical and electrical toys which can be arranged in such a variety of models; of radio design and modelling; of dolls for which so many kinds of clothes of fashion may be made. Or, better, witness the success of the Junior science club movement, now national in its scope, with its annual exhibition of materials designed and made largely in extra-curricular time. It is the active side, the experimental side of chemistry that is attractive to most high school students, and which, in turn, stimulates the more common but more prosaic method of book study.

There is a practical side to the study of elementary chemistry, especially for the great body of students whose formal education ends with the high school. In such a study there is commonly learned what really is underneath and essential about some of the most common phenomena of the individual, the home and the industries. Among these phenomena are burning, breathing, digestion, growth, decay, rusting, photography, paints and their drying, methods of obtaining metals from ores, etc. Often I have wondered that so many thoroughly educated people are ignorant of the chemistry side of these common phenomena. But should it be surprising? Chemistry is not absorbed, as is so large a per cent of other knowledge we acquire, just by living amidst it. Perhaps

(Continued on page 27)

Biology Laboratory Atmosphere

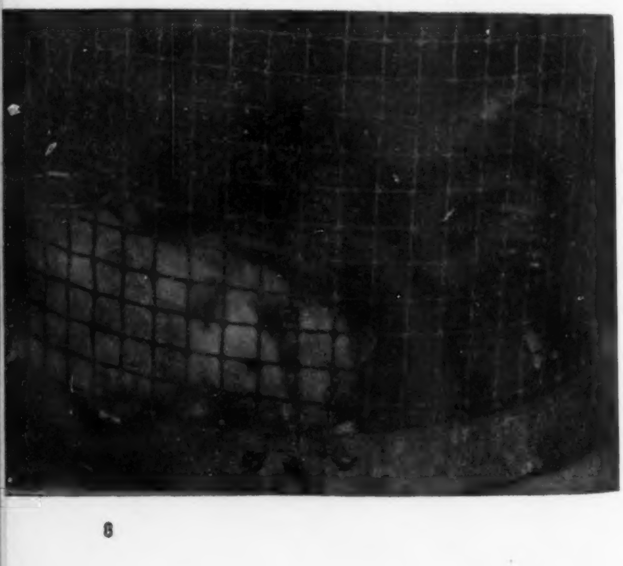
O. RUTH SPENCER

Moline High School — Moline, Illinois

WEBSTER DEFINES a laboratory as a place devoted to experimental study and atmosphere as that more or less indefinable something in surroundings which unknowingly affects the spirit or emotion of an individual, thereby influencing his reactions either positively or negatively. A teacher has gone far in making biology a living subject to her students when she succeeds in creating an ever-present, stimulating laboratory atmosphere

The old maxim, doing is fixing, is really the basis for creating this atmosphere that both inspires and teaches. At first the pupil may not be at all interested in birds, insects, or plants but show him a birdbox, an attractive display of colorful insects, or a combination of curious-looking plants and in the majority of instances his curiosity is estimated to the extent that such questions as — where did you get these, why are there so many colors, what does it eat, where does this one live, and could I find some like these — are thrown at you so fast it is impossible to answer them. This is the golden opportunity for referring to various books from which the student can glean

Animals Attract Students



the information he needs to answer his own questions. Such knowledge is retained a longer time, for he has answered his questions rather than those asked by you. Having this small background of information and an innate desire to improve on what you have shown him, he plans his own learning activity and invariably goes deeper into the questions of what, how, and why.

IT SEEMS TO ME as teachers we have two major responsibilities in the learning process — first, the stimulating of the student's interest and curiosity, both of which are very dependent upon atmosphere, and second, the directing of his activity in such a way as to satisfy his curiosity constructively and instructively. It is primarily with the problem of stimulating student interest that we shall concern ourselves in this short discussion, for once this interest is established, the actual learning follows readily.

Since biology is the study of life, there is no better way of creating atmosphere than by having living plants and animals in conspicuous places. Seldom does either an adult or a student enter a classroom where living forms are in evidence without commenting on them or asking questions about them. Then, when possible, each student table should be the center of constantly changing experiments and activities for those, too, do a great deal towards creating atmosphere, since the chance to see the live forms at close range as well as to work directly with them adds much to student interest. If each student is made responsible for answering the questions about those forms on his table there is an immediate stimulus for learning, for he will soon realize that the only way to maintain his standing as an authority is by having the facts he needs, and what "teen age" individual does not take pride in being asked to give the final word. The following suggestions are a few of the possibilities which may be displayed at various times

An aquarium and terrarium develop student interest

during the year as they fit in with classwork:

1. Small trays of growing seedlings, such seeds as corn, peas, or beans, germinate readily and are easily obtained.
2. Germinating radish seeds to show root hairs. Almost invariably the questioning statement — they do look like hairs, don't they? — follows the first observation, and such outright questions as, why aren't there any at the very tip, and are they always on roots, give a splendid opportunity for developing certain biological facts and principles.
3. Bud development shown by twigs in jars of water. When possible, this demonstration should follow the study of stems and buds, for it is a real revelation to most students how such a small compact knot pushes out into stem and leaves, and perhaps flowers. One of the best stems to use for detailed study is the lilac, but cottonwood, hickory, horse chestnut and willow can be used for comparison.
4. Bread mold in its stages of development will hold the class interest for several weeks if it is kept moist under bell jars or in small covered glass jars.
5. Nothing is more fascinating than a series of lamp chimney or glass jar displays of stages in the development of many common insects.

   One of the commonest, and also most satisfactory is the milkweed caterpillar, which, if obtained near the end of its feeding period, will pupate and then emerge as an adult, the monarch butterfly, in from two to three weeks time. There is very evident interest as the beautiful bright green pupal case begins to darken. Invariably the question, is it dead, is asked repeatedly. Other larvae which are typical but quite different from the milkweed larva are the so-called tomato worms and celery worms.
6. Live animals in small cages are always clusters of interest whether it be snakes, turtles, toads, or a bat. One snake, particularly if it is unusual in size, markings, or habits, is just like a magnet, for it draws both students (not all from the biology classes either) as well as other snakes. Some of us may have a feeling of repulsion for snakes, but every biology class has its hero and not infrequently it is the "problem boy."

MUCH AS THESE student activity centers contribute to atmosphere, there is need for other and more conspicuous, room-permeating types. In this group, living plants are probably the most outstanding, for what is a biology room without growing plants and of course the more varieties the more interest.

The following plants are easily obtained, (many are easily started from slips, from volunteer shoots, or by dividing a large plant, and students are often glad to bring these from their homes in the fall), and easily grown, as well as affording a contrast in foliage:

Philodendron, Sansevieria, Grape ivy, Wandering jew, Asparagus fern, Geraniums, Coleus (this group is especially spectacular in its many and varied color

patterns), Begonias, Ferus-Boston, table holly, Maidenhair, and the common Opuntia cactus as well as many others which can be obtained from time to time at the dime store put up in varied collections. Many of these plants are easily started from slips, from volunteer shoots, or by dividing a large plant. Students are often glad to bring these from their homes in the fall.

Very closely associated with plants is the aquaria with its ever active goldfish (if you have never competed with newly acquired goldfish you have missed out on some real competition) and the desert, bog, or marsh terraria. Most of our biological supply houses give lists of suggested materials for these as well as directions for setting them up. Perhaps the cost of establishing the terraria has proven a hindrance to many, but covered refrigerator dishes of plain glass can be purchased very reasonably. Although they are small they do attract and interest the students often to the extent that they fix similar ones for themselves at home.

A BULLETIN board display planned and maintained by the students contributes a fair share to a biological atmosphere of activity. A few which have proven popular in our school are:

1. Pictures and cartoons to illustrate class work.
2. Student work from class or laboratory. This generally proves more satisfactory if the students, either selected by the class or appointed by the teacher, are the judges.
3. Bird activities such as migration routes shown by various colored strings and correspondingly colored thumb tacks. In the spring bird pictures can be added as the return of birds is reported by the class members.
4. Classification relationships can be worked out by a series of pictures or drawings.
5. One of the means of creating atmosphere which I have used the last two years and apparently with desirable results is a biology thought for each week copied neatly and conspicuously on the upper part of one of the blackboards—this thought is not erased until the end of the week when it is replaced by a new one. I use short quotations from outstanding poets, authors, statesmen(or conservationists many of which are already familiar to the students but associated with English, not biology. I was quite pleased after having these quotations for only three weeks to have one of the boys bring in something he liked, wondering if it could be used. This volunteer help has been repeated by other students several times and this,

(Continued on page 17)

An attractive bulletin board will help teach biology

Science For Society

EDITED BY JOSEPH SINGERMAN

A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Science and Democracy

Science is Democracy in its Universality and in its Respect for Minority Opinion.

WHEN MY STUDENTS come to learn science, they should know that in science there is democracy. They should know that among scientists minority opinions are respected and, further, that the formulating of opinions (scientists call them hypotheses and theories) is encouraged. It is true, in the early days when people feared science because they did not realize its value, the great leaders of science were harassed and persecuted. However, our society would still be in the middle ages had not Harvey struggled against prejudice to convince the world that blood circulates and had not Darwin had the courage to defend his idea of evolution against the most bitter religious prejudice of his time. These men propounded minority opinions. My students should know that Lavoisier's antiphlogistine theory, Mendel's theory of unit characters, Dalton's atomic theory, and Pasteur's germ theory of disease were, when first stated, minority opinions. Had scientists refused to permit the expression of minority opinion, science today would still be in the black magic stage. As freedom of thought and expression is the cornerstone of democracy, we might well say that science is democracy.

My students should know that the "world of tomorrow" lives in the science of today. The battle against diphtheria has been led by Germans (Klebs, Loeffler, Behring), Americans (Biggs, Park, Schick, Zingher), French (Roux, Ramon), English (Glennie), Canadian (Fitzgerald) and Japanese (Kitasato). Science is built up by the co-operative effort of science workers, regardless of nationality and its benefits are available to all mankind. The origin of science is everywhere; its application is universal.

WHEN MY STUDENTS cite instances of the suppression of minority opinions and compare these with the persecutions of Galileo, Priestly and Vesalius, I know that they are acquiring more than an academic understanding of the cornerstones of democracy, freedom of thought and of expression. The inroads on our intellectual freedom has gone so far that the American Association for the Advancement of Science has adopted a resolution which reads, in part, as follows:

> "We regard the expression of indpendent thought and of its free expression as a major crime against civilization itself. Yet oppression of this sort has been inflicted upon investigators, scholars, teachers and professional men in many ways, whether by governmental action, administrative coercion or extra-legal violence.
>
> "We feel it our duty to denounce all such actions as intolerable forms of tyranny.
>
> "There can be no compromise on this issue, for even the commonwealth of learning cannot endure "half slave and half free.' By our life and training as scientists and by our heritage as Americans we must stand for freedom."

There is no question that the arbitrary condemnation of new ideas tends to hamper the progress of science. Boys and girls will find this well exemplified in reading either the Life of Pasteur or Crucibles. The following argument appeared in a New England paper in 1816 when proposals were made to install gas street lamps:

> "Artificial lighting is an attempt to interfere with the divine plan of the world which called for dark during the night time—emanations of illuminating gas are injurious. Lighted streets will incline people to remain late outdoors thus leading to increase of ailments by colds. The fear of darkness will vanish and drunkeness and depravity increase."

NEEDLESS TO SAY that science continues to dispel darkness. It has taught us that in the long run it is

(Continued on page 30)

Science Clubs at Work

EDITED BY KARL F. OERLEIN

State Teachers College — California, Pennsylvania

A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Oerlein.

How to Make a Translucent Screen

MARVIN HORELICK AND ROBERT TAYLOR

SCOPE CLUB

Taylor Alderdice High School — Pittsburgh, Pennsylvania

MAKING A TRANSLUCENT screen was not chosen by accident as a project by the Scope Club, but rather was planned to meet the needs of the group. Since the club does a great deal of micro-projection work, the idea of a portable screen was soon launched. A work room next to the science classroom allows freedom to follow such activities any period of the day a club member has free time.

A translucent screen thirty-six by forty-eight inches was planned, since subjects presented upon this screen would appear sharp and clear and could be viewed from a wider angle without distortion than when shown upon an opaque screen.

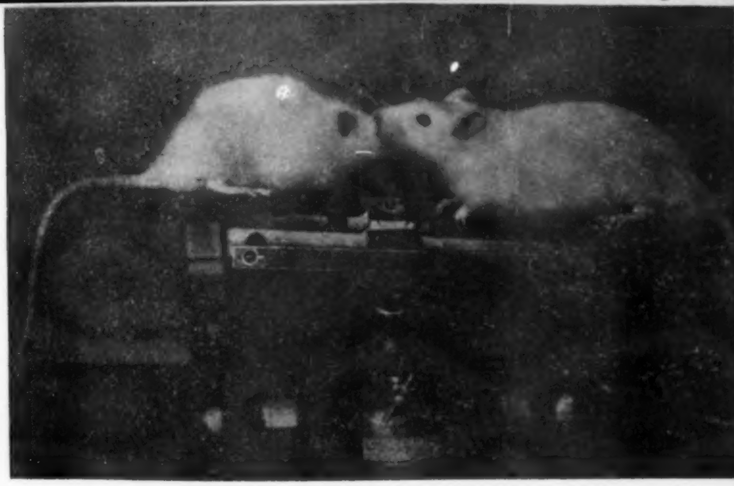
AN OAK FRAME was made in the woodshop. The music department gave us two discarded music stands for the standards which were tooled to permit raising and lowering the screen to any desired height. Unbleached muslin of good quality donated by the home economics department was washed thoroughly to remove all starch and filler and then ironed very smoothly. The muslin was cut to size, allowing an inch and a half for overlapping on the frame. Next the muslin was soaked in pure linseed oil for twenty-four hours until the fabric was thoroughly impregnated. The muslin was then folded and rolled tightly. Next it was squeezed dry enough so oil would not run from it when put on the frame. Care was taken not to make too many wrinkles. The muslin was stretched onto the frame, tacked firmly all around and was allowed to stand for three days to dry thoroughly. When completely dry it was given a good even coat of white shellac on both sides to avoid streaking. This was worked in smoothly and evenly. When it was dry it was ready for use. A molding was put over the rough edge of the muslin where it was tacked.

Translucent Screen in Use

OUR TOTAL OUTLAY was eighty cents. The price runs from thirty to forty dollars for a similar screen bought from a commercial firm.

The motion picture machine, balopticon, or microprojector may be placed in front of the screen as in ordinary projections upon an opaque screen. A little experience will prove subjects to be clearer when the machine is placed behind the screen with the audience in front.

(Editors Note—Marvin Horelick will study electrical engineering at Carnegie Institute of Technology. Robert Taylor is now majoring in science at Pennsylvania State College.)



Effect of correct and incorrect diet shown in weight and appearance of rats.

Effect of Minerals in the Diet

JOANNE WAYSTAFF

Lawrence Junior High School High School Student Lawrence, Kansas

TWO ALBINO rats were used in an experiment which lasted over a period of thirty days. One rat was fed a complete mineral diet and the other rat was fed a mineral deficient diet. They were standard twenty-five day old albino rats. The rat fed the complete mineral diet will be called Rat A and the rat fed the mineral deficient diet Rat B. Both rats weighed fifty grams and were seven and one-half inches long when the experiment was started. These measurements include the tail. The rats were kept in separate wire cages and were weighed and measured each day.

Rat A's diet consists of:

Caesin	14 parts
Lard	3 parts
Corn Starch	70 parts
Agar-agar	5 parts
Salts No. 51	7 parts
Yeast	1 part

Viostrol, 20 drops per thousand grams of diet.

Rat B's diet consists of:

Caesin	15 parts
Lard	4 parts
Corn Starch	74 parts
Agar-agar	6 parts
Yeast	1 part

Viostrol, 20 drops per thousand grams of diet.

Salts No. 51 make up the mineral content which is in Rat A's diet.

Salts No. 51 consist of:

Calcium carbonate	1.5 parts
Potassium chloride	1 part
Sodium chloride	5 parts
Magnesium oxide	2 parts
Sodium bicarbonate	7 parts
Ferric citrate	5 parts

Monobasic potassium phosphate, 1.7 parts.

THE DIFFERENCE between the two was obvious after about the fifteenth day and continued to increase throughout the remainder of the thirty days. The lack of mineral caused immediate cessation of growth, an anemic condition as evident by paling of the eyes, ears, and feet and a general unhealthy appearance. Rat A gained eighty grams while Rat B gained but forty-four grams. Rat B seemed to eat more than Rat A because he felt he wasn't quite satisfied, yet since he was not receiving sufficient minerals he did not grow or gain weight normally.

My conclusion to this experiment is that minerals are vitally necessary in the diet of rats, therefore also necessary to humans to promote normal and healthy growth. Minerals may be obtained in our diet by eating the proper foods. Foods grown directly in the ground and those obtained from animals that have these foods are the best sources of minerals. Sea foods are also good. By eating plenty of dairy products, sea food, green vegetables, meat and fruits an ample supply of rich minerals will be obtained.

Statistics in the Service of Science

CECIL B. READ

University of Wichita

Wichita, Kansas

NO ONE WOULD dare deny the growing importance of statistical methods in the fields of business, economics, and the social sciences. Even the elementary high school courses are introducing simple statistical concepts, such as the arithmetic average, median, mode, measures of dispersion, and simple representation. In fact, one sometimes wonders whether there may not be danger in the widespread use of statistical methods, without understanding of the need for intelligent interpretations and some knowledge of the limitations of various methods.

Many otherwise well informed people would say, however, that while there is a great need for statistics in the fields just mentioned, the scientist has little use for statistics. Rather than regarding statistics as a subdivision of economics, one should recognize that the statistical methods used in treating economic data have been developed in the study of the physical and biological sciences. Perhaps the misunderstanding comes from a failure to distinguish between statistics as a plural noun, in the sense of collected data; and as a singular noun, in the sense of the scientific method of treatment of such data. Let us, for the sake of avoiding argument, admit that perhaps the scientist has less need than the economist for such masses of collected data as are found, for example, in the Statistical Abstract of the United States. Where, then, does the scientist encounter a need for statistical procedures? A few instances may be worthy of mention.

MORE AND MORE the scientist is using the method of controlled experimentation, utilizing two groups, constant except for the factor being studied. Is an obtained difference significant, that is, may it be attributed to pure chance or is there a reasonable expectation that under similar circumstances a like difference might be expected? Statistics furnishes a ready means of obtaining an answer to this question.

Suppose ten students have attempted to measure a certain electrical resistance being made to 0.1 ohm. Will the arithmetic average of these ten readings give a result correct to 0.1 ohm? If not, how many readings would be necessary before we could assume such accuracy? Several problems are involved. If we have been able to eliminate irregular or accidental errors, the science of statistics tells us that we may regard the arithmetic average of n observations as an observation made with a more precise instrument, the new measure of precision being found by multiplying that of the single observation by the square root of n. In other words, we would need at least 100 readings made to 0.1 ohm to yield an average correct to 0.01 ohm. Incidentally, the teacher in the exact sciences has justification for laughing at the report made by some office secretary which states that a student has a scholastic average for the year of 85.123 per cent, obtained by averaging five marks reported to the nearest per cent.

To continue with the problem just suggested, how should one combine several observations of different degrees of accuracy? If they are to be weighted, what is the proper weight? Statistics replies: the weight should vary inversely as the square of the probable error of an observation. We see the need for the use of the statistical measure known as the probable error.

A MOMENT AGO mention was made of irregular or accidental errors. When should doubtful observations be rejected? Again we find the most acceptable criteria involve the use of the concept of the normal probabllity curve, so important in statistical theory. Of course, even with a usable formula, the old rule of "common sense" is always valuable, and even if an observation is

(Continued on page 29)

Acids and Bases from the Historical Viewpoint

E. A. WILDMAN

Earlham College — Richmond, Indiana

ATTENTION HAS been called by Professor N. F. Hall to the following methods of classifying and explaining the behavior of acids and bases:

1. The Classical or "Operational" system.
2. The Arrhenius or "Water-Ion" system.
3. The General "Solvo" system.
4. The Bronsted-Lowry or "Proton-Exchange" system.
5. The Lewis or "Dative-Bond" system.

We shall attempt to discuss these systems historically.

The chemistry of acids and bases developed out of the investigation of salts. During the twelfth century only five salts were known. They were sal g e m m a e ($NaCl$), sal ammoniacum (NH_4Cl), sal petrae ($NaNO_3$), sal alkali verum (K_2CO_3 or Na_2CO_3), and sal tartarus ($KHC_4H_4O_6$). The number of known salts increased very little during the next five hundred years. Several seventeenth century chemists (Glauber, Tachenius) were emphatic in declaring that all salts contained two opposite principles, one of which was an acid and the other an alkali, and this idea persisted throughout most of the eighteenth century. William Lewis stated in 1746, "Neutral salts are a sort of intermediate salts between acid and alkali, composed of both," and Rouelle, about 1750, said, "A neutral salt is a salt formed by the union of an acid with any substances whatever, which serves as a base for it, and imparts to it a concrete or solid form." This seems to be the beginning of the custom of calling the metal or cation of a salt a base, a custom which persists even today, although it is incorect according to either Arrhenius, Bronsted, or Lewis. Examples of the custom in modern usage are (1) the use of the term "base exchange" in connection with the behavior of the zeolite water softeners, and (2) the expression "base depletion" in describing the loss of cations from the blood.

IT MAY BE noted that William Lewis regarded acids and alkalies as salts. This idea with respect to acids persisted until the beginning of the present century, at least, and acids have frequently been described as salts of hydrogen. Hydrogen, we remember, has often been said to have metallic properties, by which it was meant that it is a cation forming element. According to Cavallo (1781) "many great chemists have believed that all acids are only modifications of a single one." This idea reminds one of the more modern view of the "Solvo" system (discussed later) that an acid is a substance that causes ionization of the solvent, the latter being the actual ion-producing material. It also seems to be an antecedent of the stress that is now laid on the oxonium ion (H_3O^+) as the principal reactive substance in water solution of acids.

TO A CONSIDERABLE extent, however, the earlier descriptions of acids, bases, and salts were "Operational" in character, that is, they were restricted to statements of experimentally observed properties. Salts were said to be compounds that are easily soluble, that affect the palate in a peculiar way, that are resistant to fire to a considerable extent, that may be decomposed to form an acid and an alkali, and that are formed by the reaction of acids with alkalies. Acids were said by Boyle (1680) to dissolve many substances, to precipitate sulfur from its solutions in alkalies, to change blue plant dyes to red, and to lose all these properties when treated with alkalies. William Lewis (1746) described acids as "all those things which taste sour upon being reduced to a proper degree of strength; such as vinegar, juice of lemons, oil of vitriol, etc., and wrich effervesce with chalk, and the salts of vegetables prepared by incineration; and with such

(Continued on page 19)

Polarized Light

KENT H. BRACEWELL

Hamline University St. Paul, Minnesota

ONE OF the most outstanding scientific achievements of the past decade has been the development of a means by which large beams of plane polarized light may be obtained at low cost.

It is said that Galileo always opened and closed a lecture with a demonstration. While I am not a devotee of ancient techniques of pedagogy, I propose to follow his practice today. Here you see a polaroid disk, by means of which this control over light is obtained. When it is placed in a beam of light you observe that light readily passes through it. Furthermore, you notice that rotation of the polaroid produces no effect upon the intensity of the transmitted beam of light. When a second polaroid, identical to the first one, and similarly oriented, is placed in the path of the beam of light from the first disk, you observe again no appreciable change in the intensity of the transmitted light. If one of the plates is rotated, however, the intensity fades and ultimately almost completely disappears. Continued rotation of either of the disks now causes the beam of light to reappear and attain a maximum of intensity. If one of the disks is rotated through a complete revolution, the intensity of the beam of light changes from a maximum to zero and back to a maximum again through two complete cycles. Thus a rotation of 90 degrees will change the beam from a maximum to zero intensity. This is the phenomenon of polarization.

NOW OBSERVE that the figure of a rose that I hold in a beam of ordinary light is quite colorless. When placed between two polaroid disks, however, the rose becomes brilliantly colored with a red blossom and green leaves. Upon rotation of one of the polaroids, the colors reverse to their complimentary colors. Again, here is a figure of a butterfly which, in ordinary light, is quite colorless. When inserted between polaroids, it, too, becomes highly colored. This time, you see not two, but four distinct simultaneous colors. A slight rotation of one of the polaroids again changes each color to its complimentary color.

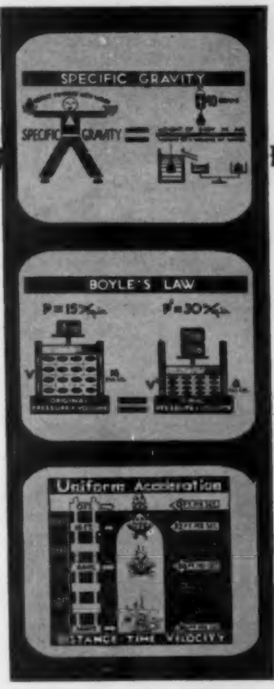
IN PHYSICAL optics, such phenomena as interference and diffraction show light to be a form of wave motion. But then, the question arises, what is the nature of the wave motion? Neither of the above phenomena, nor the famous Foucault experiment on the velocity of light in water, can answer this question, for both types of wave motion can produce interference and diffraction patterns. The answer to the question is contained in the first demonstration just exhibited, namely, the phenomenon of polarization. The conclusion is that light must be a form of transverse wave motion such as one observes in the ripples in a tank of water. There is one difference, however. Water ripples result from the force of gravity, and hence, the molecules vibrate in a vertical plane only, a direction at right angles to the direction in which the wave is advancing. Light waves, on the contrary, are not subjects to a gravitational pull in quite the same sense as the water waves, and hence, the vibrations may take place in any direction at right angles to the direction of motion of the beam. To illustrate what occurs in the phenomenon of polarization, I have prepared two slides. In the first, you see, on the left, a figure to indicate that a cord is being vibrated in all directions at right angles to its length. If the cord is passed through a narrow slot in a screen, however, one sees that the only mode of vibration transmitted is the one parallel to the slot. If the cord also passes through a second slot parallel to the first, vibrations transmitted through the first slot are also transmitted through the second. Such a vibration, in one plane only, is said to be plane polarized. In the next slide, we see that if the second slot is now rotated through 90 degrees

(Continued on page 26)

Presented before the Illinois Association of Chemistry Teachers, November 1939.

★ ★ New ★ ★ ★

VISIOGRAPH FILMROLS FOR PHYSICS



★ Visiograph Filmrols are action-illustrations in sequence from a new authorative text dealing with the theories, principles and applications of physics. Each Filmrol (non-inflammable motion picture film 33 mm. wide) contains 26 to 35 illustrations and covers one or more important division of physics. The full set of six rolls embraces 175 illustrations covering a complete standard high school course in physics and is priced at only $12.00, or slightly less than 7 cents per picture.

Each set is accompanied by lecture manual and copy of textbook "Physics Made Easy," by Louis T. Masson. Descriptive literature listing contents of each roll will be glady sent on 10-day approval plan to recognized institutions,

Complete Set of Six Visiograph Physics Filmrols

$12.00

See our catalog, either No. 46 or 48 for complete listings of Physical Instruments, Apparatus and Supplies.

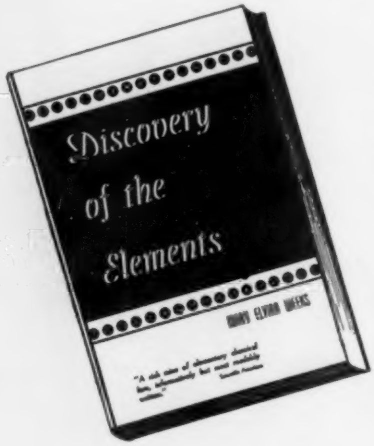
Chicago Apparatus Company

Science Laboratory Equipment

1735 NORTH ASHLAND AVENUE • CHICAGO U. S. A.

"Recommended Strongly"

by Tenney L. Davis



"DISCOVERY OF THE ELEMENTS ***is recommended strongly for its cultural value and general interest, as entertainment and as a fixative to promote the retention by the student of the facts of elementary chemistry."***

Tenney L. Davis

Dr. Davis is the preeminent authority on the History of Chemistry. He is Professor of Organic Chemistry at Massachusetts Institute of Technology and Chairman of the History of Chemistry Division of the American Chemical Society. His judgment and knowledge of the subject are universally recognized.

Some of his comments are:

"These (the new) chapters constitute important contributions to the history of chemistry.

"The account of del Rio is fascinating to read, and enhances our understanding of his times which were also the times of other men with whom the narrative of discovery is concerned.

"A greater total of interest. . . .

"The new edition is larger and more attractive than its predecessors."

But his gratifying phrase,

"Model of the sort of thing that research in the history of chemistry ought to be,"

IS HIGH PRAISE, INDEED!

JOURNAL OF CHEMICAL EDUCATION
EASTON, PENNSYLVANIA

Please send ________ copies of the FOURTH EDITION of THE DISCOVERY OF THE ELEMENTS at $3.50,* shipping charges prepaid.

☐ Remittance enclosed ☐ Send invoice

Name ____

Address ____

* $3.80 in Canada, Mexico and South America; $4.00 abroad G

AN EXCELLENT CHRISTMAS GIFT

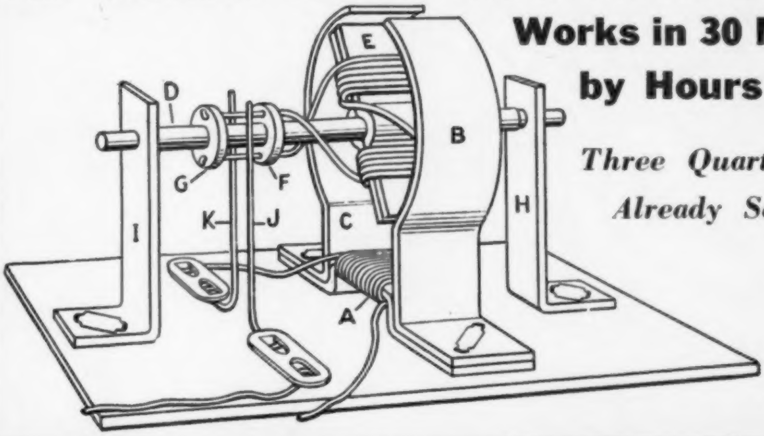
Mail the coupon and give yourself, or one of your friends, the pleasure of reading this book so highly endorsed by so great an authority. It is a reference volume that reads like a novel and, in delightful narrative style, tells all about the

DISCOVERY OF THE ELEMENTS

The Moore Educational Toy Motor for School Use.
A CLASSROOM PROJECT

When properly assembled, the motor has a speed of 6000 R.P.M. Full directions and instruction sheet —— "How a Motor Works." All parts necessary for 10c. Postage prepaid in lots of 10 or more. Individual motors 15c.

The Student Learns More About How a Motor Works in 30 Minutes Than by Hours of Study.



Three Quarters of a Million Already Sold to Schools.

Manufactured by
GEORGE W. MOORE
44 Farnsworth St.,
Boston, Mass.

Progressive Teachers---
New Material In Moving Pictures
ENJOYABLE — STIMULATING — INSTRUCTIVE — ENCOURAGES ACTIVITIES

"CHEMISTRY PROJECTS IN THE HIGH SCHOOL"—two reels. Students are shown doing five different types of projects. The work of the Illinois Junior Academy of Science is also presented. This film is especially recommended for a club program.

"A FIELD TRIP TO AN INDUSTRIAL PLANT"—one reel. Shows the processes involved in making a washing machine and also illustrates the technique of taking a field trip.

Film is available for State Science Association programs without any charge except for transportation.

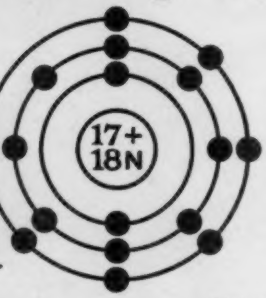
Rental---

The two films, 16 mm., silent	$1.50
The two films and a subscription to The Science Teacher for one year	$2.00
Either film and one year's subscription	$1.50

THE SCIENCE TEACHER

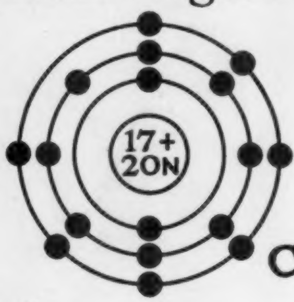
201 N. SCHOOL STREET — NORMAL, ILLINOIS

Atomic weight 35



Cl

Atomic weight 37



Cl

Recent notable advances in chemical theory and practice — among them neutrons, isotopes, heavy water, new ideas of ionization — are clearly treated in

HIGH SCHOOL CHEMISTRY

By George Howard Bruce

A textbook in which soundness and thoroughness are coupled with clarity and simplicity. After wide and successful use, the book is now offered in a Second Revision which presents a thoroughly modern and up-to-date standard high school course. **Laboratory Manual of High School Chemistry: Second Revision** by the same author.

WORLD BOOK COMPANY

2126 Prairie Avenue, Chicago

Represented by H. O. Field
27 No. Brainard Ave., La Grange

LIVING WITH SCIENCE

— BY —

Morris Meister

Principal, The Bronx High School of Science
Editor, The Science Classroom
Formerly Science Supervisor in the Junior High Schools of New York City

Written in accordance with the philosophy and objectives of the recent integrated courses of study in science. Profusely illustrated. Each chapter begins with an approach that tells a story, describes a science adventure, or draws from science biography. The pupil is led to appreciate the contributions of science as one of the most important of today's social forces.

For Seventh, Eighth and Ninth Years

THREE BOOK SERIES | SIX BOOK SERIES

CHARLES SCRIBNER'S SONS

NEW YORK SAN FRANCISCO CHICAGO BOSTON DALLAS ATLANTA

BIOLOGY LABORATORY ATMOSPHERE

(Continued from page 10)

combined with student reference to quotations from time to time, has convinced me that although the learning of them has not been required (they do copy them) none the less they have been learned at least in part and I'm sure the biological truths as stated by Bryant, Killmer, Muir, and Wordsworth will be remembered longer than what I may have said. Tennyson's Flower in the Crannied Wall, is familiar to all, and also these lines —

And he who wanders widest lifts
No more of beauty's jealous veils
Than he who from his doorway sees
The miracle of flowers and trees.
from Last Walk in Autumn,
by Whittier.

A challenge is presented through the words of Agassiz:

Come wander with me
In regions yet untrod
And read what is still unread
In the manuscript of God.

MODELS OF BOTH plant and animal types placed on a table or the top of bookcases attract attention. This is especially true if the models have been made by class members. Modeling clay is quite inexpensive and may be used a number of times.

The possibilities for project displays, made either by individual students or student groups, are unlimited. Some of the following might be thought of as suitable for the student table activity group, but for the most part the space required for their display prevents this. Each of the following suggestions requires an acquaintance with the out-of-doors and invariably the collector or observer learns much about habitat, ecological conditions, and environmental factors as he goes from place to place.

1. An insect collection of the local area can teach more to the student collector than many books, even when an alert teacher directs. It is quite surprising the number of facts which can be recalled about each insect and in the very collecting the student has learned where the insect is found, upon what it was feeding, adaptations for locomotion, whether or not it was protectively colored and many other interesting as well as accurate bits of information.
2. Closely allied to the insect collecting is the collecting and identification of various types of cocoons, chrysalids, and homes of the hymenoptera. Sometimes the identification becomes a real problem but usually the countless pictures which are available in books, magazines, and pamphlets prove more helpful than one realizes at first.
3. Who can collect twenty-five or more common weeds without learning where they grow, what their manner of growth is, what kind of flowers they produce and their efficiency in crowding out desirable plants.
4. One would be confronted with great difficulty in learning about seed dispersal were it not for our common weeds. Practically all students are amazed at the detailed structure of the seeds of the Spanish needle, cockle bur, and burdock and the intriguing arrangement in the seeds of the poppy, snapdragon, and velvet weed for dispersal.
5. Examples of diseased and injured plants prove a very effective incentive for learning about plant structure and plant reactions. Often there is someone in your locality who has made a study of some of these conditions. Perhaps there is a gardener, farmer, or horticulturist that has had experience who would be very glad to help the interested student or who would talk before a group of students. Such outside help is very desirable to bring first hand knowledge to your students as well as to serve as a link between the school and the townspeople.
6. Our common shade trees become more like real friends to anyone

(Continued on next page)

who makes a study and collection of their leaves, flowers, and fruits.

7. Local fossils hold a fascination for many and when grouped and labelled add to the appearance of the biology classroom.
8. The collection of bird nests during the winter months is a decided help in teaching. After identifying the next (Dr. Arthur Allen of Cornell has published an illustrated key which is excellent) it is only logical for the student to go further in learning more about the bird, then when spring and summer come he will be anxious to see and watch it in its natural habitat.
9. Some who may not be interested in a nest collection might be interested in building various types of bird houses. Of course, this necessitates a learning of bird preferences and also the time when they are to be placed. The life habits of the birds must be studied. What boy would build a number of such houses, place them for his bird friends, and then fail to watch the tenants which occupy them? Learning about the food habits, home cleanliness and other home responsibilities carried on so faithfully by the birds as they are watched from day to day will do much to convince the high school girl or boy of the so-called humanness of birds and their need of protection.

CHARTS (either commercial or student made) and nature pictures displayed as they coincide with various units is a means of having wall space contribute its bit to the room atmosphere which we strive to have permeate every corner. Do not allow these or any of the other displays on bulletin boards or tables to become stale — they must be changed frequently so the students will come to our classrooms in an expectant mood, wondering just what will be in evidence today or this week.

Since a laboratory is a place for experimental study a display of equipment is somewhat taken for granted, but there is need for caution as too often through carelessness it detracts from rather than add to a scientific atmosphere. If equipment is to be displayed other than in cupboards it should be just that which is needed for the unit under consideration except perhas a compound microscope which may be considered our biology insignia.

A library corner with reference material, magazines, and nature books attractively arranged creates an atmosphere which invites one to read and enjoy while learning. Even though the classroom is small and there may be a school library, the biology library corner in the biology room is most helpful.

TO SOME the mention of field trips may seem a bit out of place in a consideration of atmosphere since there are few visible results, but what is biology without excursions into the out-of-doors to study life where life exists in its natural environment? If all our biology teaching is done within four walls it is very little different from English or history. It is true that often an effective, well-organized field trip requires more preparation on our part than something to be done indoors but such a trip does encourage a definite working morale for both in and out of school that carries over a period of several weeks and even longer.

Fortunately for most teachers, the creating and maintaining of those things which establish a laboratory atmosphere are not dependent upon the sepnding of large sums of money, but much more dependent on ingenuity and determination combined with ability to gain the co-operation of the students who come under her guidance.

We must not make the mistake of the tourists who were so busy looking for a Duncan Phyfe table that they failed to give any consideration to the bed and mattress. Although atmosphere is not our final goal it is a very important requisite in effectively teaching fundamental biological principles.

ACIDS AND BASES

(Continued from page 15)

substances form a neutral salt. They are likewise distinguished from alkalies by turning syrup of violets red." An alkali, he said, "is any substance, which being mixed with an acid, ebullition and effervescense ensue thereon, and which afterwards forms a neutral salt. They are likewise distinguished from acids by turning syrup of violets green."

Lavoisier's enthusiasm for oxygen led him (1777) to make it the foundation for a classification of all compounds. He defined an acid as a radical (such as sulfur, phosphorus, carbon, nitrogen, etc.) plus oxygen; the latter he called the "acidifying principle." He even gave it its name, which means, "I make sour." In 1774 Scheele had obtained a "green-yellow gas" from muriatic acid. Lavoisier said it was the radical of muriatic acid, a radical that with oxygen formed the acid. In 1810 Davy proved this gas to be an element and named it chlorine. His work challenged Lavoisier's theory that oxygen was peculiarly the acid former and centered attention on hydrogen, which could be obtained from all acids by treatment with metals. Between 1810 and 1830 a number of other hydrogen acids that contained no oxygen were discovered, including HBr, HF, HI, HCN, HSCN, H_2S, H_2Se, H_2Te, H_2SiF_6, HBF_4.

IT MAY BE NOTED in passing that chlorine has a double claim to being a revolutionary factor in the history of chemistry — it destroyed not only the oxygen theory of acids, but also later the chemical dualistic theory of Berzelius because of its substitution compounds. It may not seem unnatural then that Berzelius was a great defender of the old oxygen theory. He held that all acids and bases were oxides against all evidence even to the end of his life.

Thomas Graham in 1833 discovered the three degrees of hydration of phosphorus pentoxide (meta-, pyro-, and ortho-phosphoric acids) and introduced the idea that acids that contain oxygen are hydrates of oxides. As a survival of this idea we still sometimes encounter the terms sulfuric hydrate, nitric hydrate, sodic hydrate, etc.

Mainly because of his work with organic acids Liebig in 1838 renounced the old classical theory of Lavoisier and Berzelius and threw the weight of his influence to the hydrogen theory. He defined acids as "compounds containing hydrogen which can be replaced by metals." This resulted in the ending of his friendship with Berzelius.

THE SCIENCE OF electrochemistry, founded in 1834 by Faraday, brought to light a great may facts that bear on the nature of acids and bases, but for many chemists for many years electrochemistry was not a respectable part of the science of chemistry and its results were not to be taken seriously. These chemists continued for years to regard acdis and bases as hydrates of oxides. But the results of electrolysis caused Daniell in 1839 to begin writing "electrolytic formulas," as $(S+4O)+Na$ — that is, Na_2SO_4 — instead of the older chemical formulas of the type $(S+3O)+NaO$ — that is $NaO.SO_3$ — such as had been used by Berzelius. Incidentally, Faraday had devised the electrolysis terms (electrode, cathode, anode, cation, anion, etc.) but Daniell, befitting his invention of the Daniell Cell, preferred the term zincode at cathode.

In 1839 Hittorf, of transference number fame, declared that **"All electrolytes are salts,"** and also, "The ions of an electrolyte cannot be combined in a stable form to whole molecules." He seems to have anticipated to a certain extent the modern theories of Bronsted and of Oebye and Huckel.

THE ARRHENIUS THEORY of electrolytic dissociation (1887) placed great emphasis on the hydrogen ion and hydroxyl ion as the essential and characteristic ions derived from all acids and all bases. When these two ions combined they produced water, hence the name "Water-Ion" system. The Arrhenius theory assumed that all electrolytes were molecular until they were dissolved in water. At the time one was dissolved it was supposed to dissociate into ions to a greater or smaller extent depending on its individual prop-

(Continued on page 22)

PROGRAM

Seventh Annual Meeting of the

AMERICAN SCIENCE TEACHERS ASSOCIATION

Associated with The American Association for the Advancement of Science.

Columbus, Ohio, December 27 and 28, 1939

Officers

President—W. L. Eikenberry, State Teachers College, Trenton, New Jersey.
1st Vice-President—Harry A. Cunningham, Kent State University, Kent, Ohio.
2nd Vice-President—Homer W. LeSourd, Milton Academy, Milton, Massachusetts.
Secretary—Deborah M. Russel, State Teachers College, Framingham, Massachusetts.
Treasurer—Louis J. Mitchell, Dansville Central High School, Dansville, New York.

Program

Board of Directors—Wednesday, December 27, 6:30 p.m. Dinner and Conference (Room 1337 Deshler-Wallick Hotel)

Morning Session—Thursday, December 28, 9:30 a.m., Hall of Mirrors, Deshler-Wallick Hotel

Presiding—W. L. Eikenberry, State Teachers College, Trenton, New Jersey.

9:30-10:15 "The Contribution of Father Neiuwland to Synthetic Rubber," Thomas Midgley, Jr., Chairman of the Board of Directors of the American Chemical Society, Worthington, Ohio.

10:20-11:05 "The Anti-Scorbutic Vitamin," Charles Glen King, Professor of Chemistry, University of Pittsburg, Pittsburg, Pennsylvania.

11:20-12:00 THE HISTORY OF SCIENCE IN MURAL PAINTING—Fifty-two scientists and a complete classification of living things. This five-year project by Elmer E. Taflinger, mural painter, and Robert Lovell Black, science teacher, will be presented and briefly explained by Robert Lovell Black, Instructor of Biology, Emmerich Manual High School, Indianapolis, Indiana.

Luncheon Meeting—Thursday, December 28, 12:30 p.m., Hall of Mirrors

Presiding—W. L. Eikenberry, President of the American Science Teachers Association

Address—"The Role of Chance in Discovery," Walter B. Cannon, President of the American Association for the Advancement of Science.

Afternoon Session—Thursday, December 28, 2:00 p.m., Hall of Mirrors, Deshler-Wallick Hotel

Presiding—H. A. Cunningham, Kent State University, Kent, Colorado

2:00- 2:15 Announcements.

2:15- 2:50 "Outstanding Problems of Junior Academies and Possible Solutions," Anna Augusta Schnieb, Professor of Education and Psychology, Eastern Kentucky Teachers College, Richmond, Kentucky.

3:30- 4:00 "Brooklyn Botanic Garden's Co-operation with Public Schools," C. Stuart Gager, Director, Brooklyn Botanic Garden, Brooklyn, New York.

4:00- 5:00 Business Meeting. Reports of Committees, Election of Officers.

Board of Directors—Thursday, December 28, 7:00 p.m., Deshler-Wallick Hotel.

Exhibits—There will be an exhibit by the du Pont Company to be used in connection with Mr. Midgley's paper on synthetic rubber. Another exhibit will be presented in connection with the paper on Junior Academies.

The American Nature Study Society will hold its meetings on Friday, December 29 and Saturday, December 30. For particulars write to Nellie F. Matlock, 5540 Pershing Ave., St. Louis, Missouri.

SCIENCE TEACHERS' NOTES

A Service for Teachers--by Teachers

Immediately helps the busy teacher by making materials more accessible and usable.

★ ★ ★

Provides---

- ★ Analytical reference list arranged by teaching topics.
- ★ Sources of free commercial exhibit materials.
- ★ Sources of free or low cost supplementary science material.
- ★ Film lists in science grouped by teaching topics.

Needed---

Because no teacher working alone can keep up to date on useful materials, but through the combined efforts of many teachers it is possible.

Kept Up-to-Date---

Science Teachers' Notes are printed from typewritten copy on 8½ x 11 paper punched for insertion in a looseleaf notebook. Out-of-date material may be removed and new material inserted as supplied. The service is kept revised from year to year.

★ ★ ★

The Work of Trained and Experienced Teachers Provided for subscribers of The Science Teacher

★

Available in February, 1940

★

Published by

The Science Teacher

201 N. SCHOOL STREET NORMAL, ILL.

★

Members of associations served by journal may receive service at cost.

THE SCIENCE TEACHER,
201 N. School St., Normal, Ill.

I am enclosing..................to cover the cost of

☐ three years' subscription to The Science Teacher and Science Teachers' Notes, including up-to-date service, for $3.00;

☐ two years' subscription to The Science Teacher and Science Teachers' Notes for $2.25.

Name..................

Address..................

ACIDS AND BASES

(Continued from page 19)

erty and on its concentration. There was thus added to the list of types of chemical reactions a new one — ionization.

Before long the Arrhenius theory was generally accepted. There was some opposition, to be sure, some chemists asking rather unintelligently how water could decompose a substance that can withstand fire (meaning a salt)? They might better have pointed out that the new reaction of ionization had been attributed indiscriminately to all electrolytes without knowledge as to whether those substances existed as neutral molecules before they were dissolved.

However, that would have required the acumen of Hittorf. The Arrhenius theory was too successful. An entire generation of chemists accepted it almost uncritically and even yet there are many who think it is the final word with respect to electrolytes. One evidence of this is the slowness with which modern conceptions of electrolytes and of the acid-base function have been introduced into general chemistry textbooks. Authors of popular textbooks feel that they must follow their constituency or else lose sales.

To a limited extent attention was turned toward the function of the solvent by A. Werner between 1893 and 1913, the year he died. He proposed that an acid molecule combined with a water molecule before ionization and that the subsequent ionization involved not the original acid molecule but the water molecule; and similarly for bases.

IN 1923 BRONSTED and Lowry independently developed the proton exchange system. The acid is defined as a substance that contains a mobile proton (or any hydrogen nucleus), and a base as a substance that may combine with a mobile proton. Thus an acid is of any of such a varied list of substances as hydrogen chloride molecules, water molecules, bisulfate anions, ammonium cations, aluminum cation hydrate, etc. Bases are such substances as chloride ions, water molecules, hydroxyl ions and oxide ions, bisulfate anions and sulfate anions, ammonia molecules, and aluminate anions. Water is amphiprotic, that is, it may act as a base in reactions that form the oxonium ion, such as, $HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$, and it may act as an acid in the reaction with itself that takes place to a very small extent, $H_2O + H_2O \rightleftharpoons H_3OH^+ + OH^-$, and in the reaction with oxide ion which takes place almost completely, $H_2O + O^{--} \rightarrow 2OH^-$. The inclusion of such substances as water and bisulfate ion in both the acid list and the base list is possible because substances are acids or bases depending on how they react toward another particular substance and their behavior may change with circumstances. Thus, bisulfate ion is an acid toward hydroxyl ion and a base toward hydrogen chloride (in the reaction between sodium bisulfate and hydrochloric acid, both in concentrated solution).

THIS THEORY seems to give us a more nearly true idea of acids and bases than that of Arrhenius. It applies to solutions in any solvent. It places Franklin's ammonia chemistry in the same category with the more familiar water chemistry. It includes acid and base catalyzed reactions in non-polar solvents such as benzene in which the reactants are not ionic. The theory does not require that acids and bases must be ionic in order to exhibit their characteristic properties. To some chemists it seems like a too-drastic break with the classical theory of Arrhenius.

But to a few, among them G. N. Lewis, it seems to stop short of the truth as we now see it. He points out the fact that a base is a substance that contains a pair of electrons which may be shared with a proton or other similar substance, and that an acid is a proton or other substance that may use the electron pair to form a valence bond with the base. This conception if applied generally extends greatly the list of substances that function as acids. For instance, Lewis mentions sulfur trioxide, boron trifluoride, stannic chloride, silver

(Continued on page 28)

NEW SCIENCE BOOKS

Just off the Press!

NEW CHEMISTRY GUIDE AND LABORATORY EXERCISES.
A brand new book just off the press — entirely reset, new types of experiments, new pictures, and new format. This book retains the tested features that have made it the most popular study guide and laboratory manual in the United States. It initiates some new features, including a few new-type experiments and a few new-type exercises.

NEW LEARNING GUIDES IN GENERAL SCIENCE (Seventh Grade and Eighth Grade).
Two new books just off the press following, in general, the procedure used in our Learning Guide in General Science for the Ninth Grade. This series is an outstanding series in the field of general science.

CHEMISTRY AND YOU.
A new type of text that is sweeping the country. New pedagogy, new organization, new method of presentation. This book has been called one of the most interesting chemistry texts written.

CHEMISTRY AND YOU IN THE LABORATORY.
A straight laboratory manual for use with Chemistry and You. Published in two editions, a cloth-bound edition and a consumable edition. These books are very low in price and adequate in every detail.

SCIENCE TESTS.
New Chemistry Unit and Review Tests. General Science Unit Tests — three different tests for grades 7, 8, and 9.

OTHER SCIENCE WINNERS

LEARNING GUIDE IN BIOLOGY.
A best seller. A combination laboratory manual, study guide, review program, and free testing program.

NEW PHYSICS GUIDE AND LABORATORY EXERCISES.
One of the most popular combination study guides and lab manuals in this field.

LYONS AND CARNAHAN

CHICAGO DALLAS SAN FRANCISCO ATLANTA NEW YORK

SOME COMMON CHICKEN LICE

(Continued from page 3)

AS A PART of the study of these lice the class may be divided into groups of four or five students and each group treat several fowls for lice using sodium fluoride either as a dust or dip.

Another procedure that is always interesting is to treat the roosts in a chicken house with 40 per cent nicotine sulphate, and place ordinary wrapping paper under the roosts, leaving them overnight. The next morning when these papers are taken up a varying number of lice will be found on them. These were of course overcome by the nicotine fumes during the night and dropped from the chicken's body. This is one way to convince a class that lice do exist as described and that this method of control is effective.

THERE IS even a quicker and easier way to demonstrate the presence of lice and the effectiveness of nicotine sulphate. Select a fowl that is thought to be infested with lice, place a single drop of 40 per cent nicotine sulphate on the back of the neck and another drop about three inches below the vent. Return the bird to the coop or box with a paper in the bottom which can be removed. In fifteen or twenty minutes remove the paper and examine. In practically every case lice will be found, having dropped when overcome by nicotine fumes.

In addition to the lice, there are several kinds of mites which are important pests of poultry in the United States. We want to discuss only one of these.

Mites are relatives of insects but are not insects. The easiest way to distinguish them from insects is that mites have eight legs while insects have six. Also the mite's body is all in one place while the insects's body is divided into three main parts.

The common chicken mite lives in cracks about the roosts, floors, and walls of the houses in the daytime and crawls upon the fowls at night or when they are on the nest. Very few mites are found on fowls during the day. Blood of fowls is their normal food, which they draw through sharp piercing mouth parts.

THE EGGS of the mite are white and very small. They are deposited in dark protected places such as cracks about the poultry house. The eggs hatch in two to four days generally. The mite becomes grown in only one week to 10 days. During this time it has fed several times on the blood of the host. The adult is 1-40 to 1-30 inch long, and when filled with blood is bright red to almost black. It is then ready to deposit eggs as already described. The mites are not active during winter, except in heated houses, the numbers become greatly reduced and they may seem to disappear for a time. When spring appears they become active and can soon build up to great numbers. Fowls which are victims of these creatures become droopy, pale about the head, listless, and may stop laying. Chicks and setting hens often die.

Although not hard to kill, the greatest difficulty is reaching the mites in their hiding places. A thorough cleaning of the chicken houses and spraying with some suitable material is generally all that is necessary. All roosts, loose boards, and boxes should be removed and the material applied with a pump or sprayer. One of the best substances for the purpose is a mixture of three parts of waste crank case oil and one part kerosene. The creosote stock dips will destroy all mites reached by the spray, and, in addition, their germ-killing properties are a desirable feature. Whatever material is used, the fowls should be kept out of the house until the fluid has thoroughly soaked into the wood. The floor should also be treated as many mites fall when the roosts are being removed.

IT HAS BEEN shown (5, 6) that the common poultry mite is capable of transmitting certain diseases of poultry. So in addition to the damage this mite can do by blood-sucking there is the possibility of its acting as a disease carrier from sick to well chickens. So far, one of these diseases (Spirochaetosis) has not become established in the United States, the other (Leukosis) is present.

Everyone can easily understand how lice might be carried from place to place on the body of an infested fowl. Also how chickens may carry a few mites in their feathers during the day following a night spent in infested quarters, and thus transport them to a new place. In addition to this common method of spread there is evidence (4) at hand which indicates that the English sparrow may and probably does carry mites and lice.

Bibliography.

(1) Bishop, F. C., and Wood, H. P., 1931 rev. Mites and lice on poultry. U. S. D. A. Far. Bul. 801.

(2) Buckley, J. S., Bunyea, H., and Cram, E. B., 1939 rev. Diseases and parasites of poultry. U. S. D. A. Farm. Bul. 1652.

(3) Herrick, G. W., 1915. Some external parasites of poultry. Cornell Agr. Exp. Sta., Bul. 359.

(4) Hoyle, W. L., 1938. Transmission of poultry parasites by birds with special reference to the "English" or house sparrow and chickens. Trans. Kansas Acad. Sci. 41: 379-384.

(5) Hungerford, T. G., and Hart, L., 1937. Fowl tick fever. Agric. Gazette of New South Wales. 48: 591-592.

(6) Johnson, E. P., 1939. Transmission of fowl leukosis. Poultry Science 16 (4-: 255-260.

(7) Metcalf, C. L., and Flint, W. P., 1939. Destructive and Useful Insects. Pages 861-871. McGraw-Hill Book Co.

PROJECTS AVAILABLE

Those desiring project material in science will find the Project Kit edited by Miss Ernestine M. J. Long of Normandy High School, St. Louis, Missouri of much interest. There are about twenty-four projects in the group. Most of them are somewhat brief in description, but contain the essential information for doing them. These projects have been collected by Miss Long from a number of teachers and have been mimeographed and distributed to the teachers of the Missouri and St. Louis Junior Academies of Scieace as a service to them. In order to cover the cost of stencils and paper the remainder of the group are being offered to teachers at the very nominal charge of thirty-five cents (including postage). Write to Miss Long at once before the supply is exhausted.

SCIENCE
FOR THE WORLD OF TOMORROW

By Gerald Wendt

Director of Science, N. Y. World's Fair

Outmoded pedagogy considered science as a great body of knowledge, a vast encyclopedia of facts and principles, a gigantic collection of useful instruments and machines. Taking the modern viewpoint that science essentially is a method of solving problems — problems that in the main concern man and his welfare — the author evaluates scientific progress in terms of human values. By analyzing the forces which have produced the world today, he projects upon a broad canvas a fascinating vision of the world of tomorrow. 70 illustrations. $2.75.

A Scientific Book Club Selection

MATTER AND LIGHT

By Louis de Broglie

Member de l'Institut, Nobel Prize Award 1927, Professor of the Faculty of Science, Paris

The results of modern physical research are probably the most vital product of the twentieth century. Recent investigations demonstrating the affinity between light and matter appear to some observers to go to the very root of an understanding of the physical universe. One of the most distinguished workers in this field here presents studies on this and related aspects of contemporary physics. Subjects included are a general survey of present-day physics, matter and electricity, light and radiation, wave-mechanics, etc. $3.50.

W. W. Norton & Co.

70 FIFTH AVENUE, NEW YORK

POLARIZED LIGHT

(Continued from page 16)

grees, the vibrations transmitted by the first slot are now absorbed by the second, and hence, no vibrations are transmitted by the system. Since the action of a pair of polaroid disks upon light is similar to that of the slots upon a vibrating cord, we must conclude that light is not only a form of wave motion, but that the form is transverse.

THE FIRST recorded discovery of phenomenon in polarized light was made by Bartholinus of Denmark in 1670, who discovered that an object, viewed through a crystal of Iceland spar appeared double. Bartholinus correctly reasoned that the crystal broke a beam of light into two beams The phenomenon is explained by the accompanying slide, where one sees that the incident ray is broken into two beams. If the rhombohedron is rotated about the axis of the beam of light, it is found that one beam remains stationary while the second rotates in a circle about the first one. It is found by experiment that the first ray obeys all of the ordinary laws of geometrical optics, and hence, is called the ordinary ray. Since the second ray does not follow the ordinary laws of geometrical optics, it is called the extraordinary ray. Further examination shows that the two beams are each plane polarized at right angles to each other and that in the case of spar, the velocity of the E beam is greater than that of the O beam.

A PHYSICIST named Nicol discovered a way of cutting spar crystal so as to remove one of the two beams. The resultant light was thus plane polarized. Such crystals, known as nicol prisms, constituted, until recently, the best and usual means of obtaining a beam of plane polarized light. Since few large spar crystals are in existence, nicol prisms are usually small in size and quite expensive. I believe the largest nicol in existence is in the laboratory at Kensington, England. It has an aperture of four inches and cost about a quarter of a million dollars. These facts, combined with the fact that most phenomena require two nicols for execution has meant that observation of many beautiful phenomena in polarized light has been limited, until recently, to a comparatively few students in well-equipped laboratories.

In 1852, Prof. Herapath[1] discovered thatcrystals identified[2] as iodosulphate of quinine possessed the property of polarizing a beam of light. He became quite enthusiastic over the possibility of growing large crystals artificially. There followed a series of papers[3 4 5] dealing with his efforts to grow large crystals. While he did succeed in mounting a few of these crystals, they were unfortunately so extremely fragile that the slightest vibration destroyed them and the work was ultimately dropped.

THE LATEST chapter in this interesting story was written about five years ago when a man named Edwin H. Land came to Dr. Wheelwright, a young instructor in physics at Harvard University, and showed him a process he had developed for securing large sections of a polarizing film. Strangely enough, the new process was the exact anthesis of the plan of Herapath. Instead of growing single large crystals of iodosulphate of quinine, Land immersed a suspension of millions of submicroscopic crystals in a film of plastic cellulose acetate. By a process of stretching the film while still plastic, the tiny crystals were almost perfectly aligned, thus forming a film of any desired size that would accomplish the same effect as a single large crystal. This film, named "POLAROID," is stable up to 250 degrees F., and polarizes 99.8% of an incident beam of ordinary light. It transmits about 37% of the beam.

1 Herapath, W. D. Phil. Mag. 3, 161 (1852).
2 Herapath, W. D. Phil. Mag. 4, 186 (1852).
3 Herapath, W. D. Phil. Mag. 6, 346 (1853).
4 Herapath, W. D. Phil. Mag. 7, 352 (1854).
5 Herapath, W. D. Phil. Mag. 9, 366 (1855).

CHEMISTRY IN HIGH SCHOOL

(Continued from page 7)

it is the only subject taught in the high school that is not, in some sense, a continuation of what has gone before, and about which we know little at the start. It is a wholly unknown region, a fairy land, to all who have not formally entered its boundary. To those whose education may be limited it must be an element of satisfaction and pleasure throughout life to have entered even the border of that land so as to understand a little better the common changes noted in everyday occurrence. Through chemistry the world and living become ever more wonderful, but also somewhat more intelligible.

CHEMISTRY also offers a good opportunity for clear thinking, including both inductive and deductive logic. Probably no subject studied in the high school, other than mathematics, offers as good an opportunity for continual practice in this necessary type of education. In the laboratory many facts are observed and such a relation among them that a logical deduction or conclusion seems natural and necessary. Certain causes produce constant effects. Under the guidance of teachers certain conclusions lead to generalizations, and to theories to explain them. From the theories new facts are predicted and then sought for in well thought out experiments. This may be considered the most difficult phase of the learning process. But by repeated demonstration and illustration logical thinking becomes a habit of the mind in the face of any problem that arises. More or less certainly the mind is stimulated by this type of education, chemistry being one of the possible tools. Certainly the high school age level is not too early to use the scientific method which is becoming the method of the world.

FINALLY, chemistry more than most other fields of study, including the other sciences, has its practical or industrial side. Many young people wish to secure a broad education which at the same time will furnish them with the

HESSLER - SHOUDY

UNDERSTANDING OUR ENVIRONMENT

A one-volume course in general science for the ninth year

ECKELS - SHAVER - HOWARD

OUR PHYSICAL WORLD

An advanced course in the physical sciences
for the eleventh or twelfth year

Here are two new books that make a definite contribution to the knowledge and understanding of the modern interpretations and implications of the sciences.

BENJ. H. SANBORN & CO.

221 EAST 20TH STREET CHICAGO

To Secure Assured Pupil Participation
To Secure Eager Pupil Response

— U S E —

A Combined Laboratory Manual and Workbook in Biology
BY DAVIS AND DAVIS

A Combined Laboratory Manual and Workbook in Chemistry
BY CONN AND BRISCOE

A Combined Laboratory Manual and Workbook in Physics
BY COOK AND DAVIS

Directed Studies in General Science
BY PAINTER AND SKEWES

Directed Studies in Biology
BY HANGER AND LOWE

Each of the above combines laboratory manual, study guide, testing service and review programs, all carefully integrated.
Material and activities carefully considered as to appropriatenes for the grade level intended.

CORRESPONDENCE INVITED.

MENTZER, BUSH AND COMPANY

2210 SOUTH PARK WAY — CHICAGO, ILLINOIS

foundation of knowledge for a life work. In many cases the latter is so imperative that it becomes, for the moment, the chief motivating interest in their young lives. They are about ready to fly out of the home nest. Some have already tried their wings. High school is just ahead. Some are now interested in some phase of science, often chemistry; others become interested as soon as they encounter a science study. In a general way high school boys know that thousands of men and women are employed in the chemical industries. Many of the larger industries are controlled by chemists and much of the newer materials and methods are the result of chemical research. All this appeals to the ambition and interest of youth. Many think they want to enter the chemical field. Does not the high school have a duty here in giving these young people an early chance to try themselves out and perchance begin what may develop into a life work of satisfaction and honor for the individual, and added knowledge for the industry and the world?

ACIDS AND BASES

(Continued from page 22)

perchlorate, sulfur dioxide, and carbon dioxide. It is interesting to note that sulfur trioxide is again an acid according to this modern theory, but for more involved reasons than it was an acid to Lavoisier and Berzelius.

It has been the intention in this paper to describe briefly the various conceptions that chemists have held with respect to acids and bases in order that by contemplating them we may gain perspective. It should help us to decide what views are reasonable and it should save us from the common error of thinking of the Arrhenius theory as something akin to final truth.

(Address delivered to the meeting of the Indiana High School Chemistry Teachers' Association on April 14, 1939.)

STATISTICS IN SCIENCE

(Continued from page 14)

not included in the computations, it should always be recorded unless the reason for the mistake can be clearly determined.

In the biological sciences one frequently finds peculiar conditions, with need for special statistical devices to handle the problem of experimentation where the number of subjects is necessarily small. At least one standard treatise on statistical methods is devoted to problems confronting the research worker in this and similar fields.

We study not only the amount of variation, but the form, and as a special case the simultaneous variation of two or more sets of observation. Another important concept is the determination of the amount of departure from normality. In recent years much time has been devoted to the proper statistical treatment of the methods of plot experimentation used in field experiments in agricultural work.

NO MENTION has been made up to this point of the tremendous possibilities existing in the many graphical methods available. A very important problem arising when we attempt to analyze experimental data is that of finding the mathematical equation which will best express the results; or in other words, finding the best-fitting curve. Again the science of statistics attempts to answer such questions as: what is meant by best-fitting?

Many people unfortunate enough never to have had even an elementary course in statistics have no idea that any of the problems just presented could even be considered statistical; even more unfortunate is the person who has failed to realize the many opportunities for application to scientific fields information available in most standard works on statistics. Many more observations could be given — the important thing is that statistics is more than a collected mass of data; it is a method by which we attempt to interpret results.

ADVENTURES WITH LIVING THINGS

A GENERAL BIOLOGY

A logical, step-by-step development carefully matching the pupil's gradual growth in knowledge, understanding, and power. Emphasis on functional and social aspects, and on the inculcation of scientific attitudes and habits of scientific thinking. Excellent illustrations; varied exercises, discussion problems, and activities program. **Helpful, comprehensive TEACHER'S MANUAL available.**

By* ELSBETH KROEBER, *James Madison High School,* and WALTER H. WOLFF, *DeWitt Clinton High School, New York

D. C. HEATH AND COMPANY

1815 Prairie Avenue, Chicago, Illinois

SCIENCE AND DEMOCRACY

(Continued from page 11)

worthwhile to weigh and consider new ideas with an open mind.

Today is a time for careful thinking. Our judgments concerning the ideas and opinions of minority groups, whether in science or not, should be based on facts. Professor Edwin Grant Conklin has recently stated, "While accepting majority rule as expressed in free elections, it (democracy) must defend the rights of minorities to try to change majority opinion by peaceful methods of criticism, persuasion and education."[1] No one regrets that Jenner was permitted, through peaceful methods of criticism, persuasion and education, to convince the world of the potential value of vaccination; that Mendelejeff was permitted to expound his views on the family of elements; or that Galileo was permitted, despite the severity of current reaction, to place his discoveries and theories into the record. Students in science readily understand the necessity for considering all the facts in regard to a question before arriving at a final decision.

THE REVERSES met by democracy in many parts of the world today are a real challenge to our youth. Harold Rugg in his book, Democracy and the Curriculum, states, " . . . democracy has not been defeated by superior strength; instead, it has been deserted by its own false leaders, typified best by the Tory imperialistic governing classes of Great Britian."

The rapidly changing conditions of the present require rapid adjustments and clear thinking in regard to government and social groups. There are always differences of opinion. In the confusion now existing in the minds of men in regard to the functioning of democratic government, it appears that teachers of science may have an important part in leading the citizens of tomorrow to have respect for and to give consideration to minority groups and minority opinion.

1 Journal of National Educational Association September, 1937.

THE HOLT SCIENCE SERIES

General Science — SCIENCE * — Davis and Sharpe

Biology — BIOLOGY * — Moon and Mann

A GUIDE AND WORKBOOK IN BIOLOGY — Clinton G. Weymouth

Physical Science — DESCRIPTIVE CHEMISTRY AND PHYSICS — Sherman R. Wilson

Chemistry — MODERN CHEMISTRY * — Charles E. Dull

UNITS IN CHEMISTRY * — Russell S. Howard

DESCRIPTIVE CHEMISTRY — Sherman R. Wilson

APPLIED CHEMISTRY — Wilson and Mullins

Physics — MODERN PHYSICS * 1939 Edition — Charles E. Dull

DESCRIPTIVE PHYSICS — Sherman R. Wilson

* Workbook to accompany

HENRY HOLT AND COMPANY

ATLANTA CHICAGO DALLAS NEW YORK SAN FRANCISCO

The Gist of It Seems to Be

Abstracts and References

The college influence on high school biology is still too great. We should remove large quantities of unimportant detail (structure of arctic plants, cell parts, cell division, spirogyra, crayfish, scientific names, classification, extensive chemical reactions, the quaint custom of studying the earthworm to understand man, etc.) to make room for more valuable material (practical information on lawns, common flowers, household plants, the study of instinct, reproduction and heredity in household pets, soil conservation, practical genetics, vocations connected with biology).—George L. Bush, "High School Biology—Its Opportunity," in S. S. & M., Nov., 1939. P. B. S.

One third to one half of our population is somewhat vitamin-starved and so somewhat non-resistant to disease. But not all of these suffer from insufficient vitamin intake. In many cases insufficient activity of the endocrine glands or such things as insufficient iron or copper intake prevents sufficient absorbtion and utilization of vitamins. It is very complicated and much knowledge remains to be discovered. However, this much is clear: universal application of our present-day nutritional knowledge would do more for the health of this nation than all its doctors and hospitals.—John C. Goffin in, "Vitamins—The Modern Miracle." American Biology Teacher, Oct., 1939. P. B S.

For biology projects, superior children like library research, dissection, feeding and breeding experiments, making individual collections; average children like to make scrapbooks, to care for pets and build cages, to make drawings, charts, or models; inferior children prefer routine care of pets, simple charts and models.—Ruth A. Dodge, in "Adventures in the Classroom," Am. Biol. Teach., Oct., 1939. P. B. S.

A racial unit — the scientist recognizes no basic superiorities among races — is presented with book references. — Maurice Bleifeld in, "A Biology Unit Dealing with Racial Attitudes," Am. Biol. Teacher, Oct., 1939. P. B. S.

"Making Explosives — Then and Now," Ernst Berl, Chem. and Met. 46, 608-614 (1939). An interesting discussion of the problems encountered by the chief chemist of the entire Austro-Hungarian munitions industry during the world war. Now an American citizen, the author shows how munitions manufacture has developed and how and why the United States is well equipped to manufacture munitions if need be. Many statements of general interest appear in this article, such as: actual powder requirements for propelling charge and shell charge in the artillery shells used. "In 1918 it took 400 projectiles to kill one individual and 80, to wound an opponent." One armored turret of the Fort of Antwerp required 122 tons of projectiles to destroy it." When St. Mihiel was captured the American troops shot more ammunition in four hours than was used during the entire Civil War.

The last few sentences tend to give the average individual some concrete information concerning the terrible waste and ineffectiveness of artillery fire.—D. G. N.

"Wet Processed Cement." (Staff) Chem. and Met. 46, 629-632 (1939). A detailed, diagrammed flow sheet of all processes encountered in the manufacture of wet processed cement by one of our larger producers. Eleven cuts illustrating interesting stages are inserted above the flow sheet at suitable locations. Interesting figures concerning the demand on raw materials required to produce 6,000 bbls. of cement daily include, 1,800 tons of limestone, 330 tons of fuel (coal), 45 tons of gypsum, 750 lbs. of explosives and 150,000 kw. hr. of electricity. D. G. N.

BOOK SHELF

Study Guide to Biology. Blanche McAvoy. 235 pages. 69 line drawings. Published by Burgess and Company, Minneapolis, Minnesota. $2.00.

"A Study Guide for Biology," by Dr. Blanche McAvoy, Illinois State Normal University, represents a type of procedure which many have awaited for some time. It is not a work book, neither is it a text book, but, being what the name indicates, it incorporates the good features of both. Instead of cramped, blank spaces to be filled in with self-obvious and stereotyped answers, it offers ample space for the encouragement of that almost forgotten practice of recording scientific results in good descriptive English. It may be used in conjunction with any text or without a text.

As to subject matter, it is a functional biology divided into nine main units. These units may better be looked upon as nine activities based upon the use of materials in season. While primarily designed as a guide for the study of actual materials and situations in present-day life, the book, unlike most manuals, is flexible enough to permit the use of demonstration, discussion, and text-book procedures. A carefully selected bibliography follows each unit.

As to format, the "Guide" is an excellent example of mimeo-printing, in spiral notebook form, containing well-executed line drawings which serve their purpose without detracting from the educational value of necessary first-hand observations on the part of the student. The publishers, Burgess Publishing Company, Minneapolis, Minnesota, have produced a book quite in keeping with the general excellence of the author's work.

Ernest M R. Lamkey.

The Anatomy of the Bullfrog. Richard R. Stuart. Distributed by Denoyer-Geppert Company, Chicago. 55 cents.

This student manual is the first of a series of manuals covering the forms commonly studied in zoology and comparative anatomy classes. Dr. Stuart has taught the bullfrog for many years and the present manual is the outgrowth of the outline his classes have used

This paper-bound book is 8½ by 11 inches with 30 pages of illustrations and index. The large page size makes possible life-size or larger drawings. There is no text, however the 33 clearly drawn figures are fully labeled.

Dr. Stuart's manual should prove popular among beginning zoology students as it will help them to dissect their specimens more intelligently.

Deserts on the March. By Paul B. Sears. 231 pages. Small drawings at the heads of chapters. University of Oklahoma Press, Norman, Oklahoma.

Paul B. Sears is a smooth and lucid writer as well as a wise and moderate ecologist. When he enters a forest or a meadow he sees not merely what is there, but what is happening there. Sears puts it into clear popular writing with as great appeal to the general reader as to the science teacher.

As the title implies, the book deals largely with soil and life conservation. But it is not limited to our own dust storms, floods, farm erosion, farm abandonment, and forest abuse. A brief but illuminating survey of the practices in China, Egypt, Europe, and Central America poses the universal problem — How to intensively use soil without ruining it.

Scientific readers will find it short of meat but long on common sense. Apparently, he does not try to solve the great social problems involved The ultimate decision does not rest with the scientist but with the citizen. The scientist's task is to clearly point out the urgency of this problem and furnish technical information. This he does very effectively.

He is a citizen, too, however, as well as a scientist, and makes a few comments on the sociological aspects. He thinks that more could be accomplished with suitable educational measures, " . . while a bird in the hand is worth two in the bush, birds breed in pairs and nest in bushes." He thinks truly private ownership with a fair system of taxation has yet to be tried. Public ownership would probably be not only corrupt and inefficient, but an added expense to our already reeling middle class.

Philip B. Sharpe.

Biology Teachers--Do You Have this Catalog?

This New Catalog was mailed recently to twenty thousand biology teachers. It is valuable to you and we want you to have it. If your copy did not reach you, please ask about it at the school office. If not located, we will gladly send one promptly without obligation to you.

Our 1940 Catalog 15B Contains—

1. **A complete listing of American Made Models for Anatomy and Biology, all fully described and priced, many illustrated.**
2. **A comprehensive selection of American Made and imported Charts for Anatomy, Health and Biology.**
3. **Fifteen pages of Demonstration Mounts, Skeletons, Living Material and Preserved Specimens for Biology.**
4. **A condensed listing of the standard Microscope and Lantern Slides for Biology.**

This Catalog giving you full information about so many helpful and necessary materials of high quality at reasonable prices will enable you to buy the best and make your budget go farther.

DENOYER-GEPPERT COMPANY

5235 RAVENSWOOD AVENUE **CHICAGO, ILLINOIS**

WHY ABSTRACTS?

A good abstract:

"(1) enables the reader to determine whether or not a paper is of sufficient interest to him to warrant his reading it;

"(2) it enables the teacher and general reader to keep themselves informed on the trend of current, biological investigations with a minimum of effort; and

"(3) it enables any reader to peruse the article more intelligently than he could otherwise."

(Smith, R. C., Jour. Ec. Ent. 31 (5): 564. N 11, 1938.)

USE BIOLOGICAL ABSTRACTS

A non-profit service by biologists for biologists, a modern necessity for every biology department library. Are you primarily a zoologist, botanist, geneticist, bacteriologist? Subscribe personally for your special section and keep up with progress. Complete annual index goes to every section subscriber.

SEND YOUR ORDER NOW!

BIOLOGICAL ABSTRACTS, University of Pennsylvania, Philadelphia, Pa.

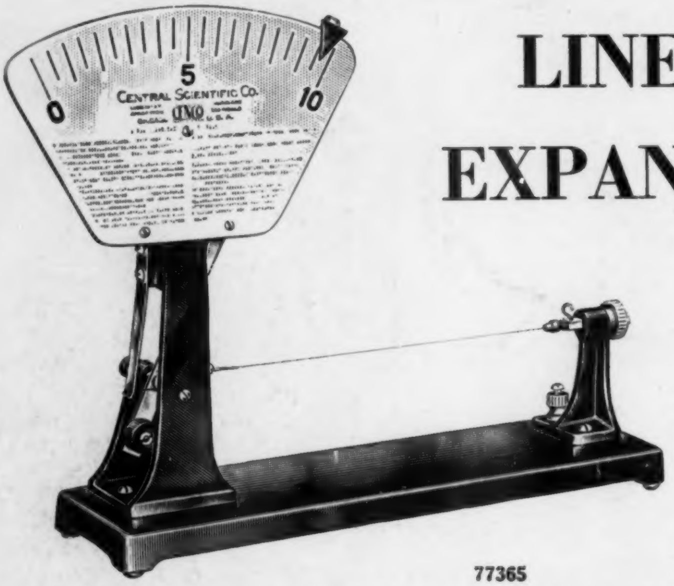
Enter my subscription to: ☐ BIOLOGICAL ABSTRACTS, (Vol. 13, 1939) at $25, postpaid.
Abstracts of ☐ General Biology at $4.* ☐ Experimental Animal Biology at $9.*
☐ Microbiology and Parasitology at $5.* ☐ Plant Sciences at $6.* ☐Animal Sciences at $6.*

Name...Address...

* Add 50c per section postage to foreign subscriptions.

A forceful demonstration of

LINEAR EXPANSION



77365

MAGNIFIED 200 times, the elongation of a measured length of wire is traced by a large pointer against a broad scale with open, easily-read graduations and figures as the wire temperature gradually rises from heat generated by the passage of an electric current through the specimen. The elongation from room temperature to 232° C provides values of a magnitude which will allow calculation of the expansion coefficient to a high degree of accuracy. The high temperature reading is that of the melting point of a piece of tin-foil suspended from the specimen under test.

With steel wire decalescence and recalescence are demonstrated by the sudden changes in the movement of the pointer. Aside from the determination of the expansion properties of wires, the apparatus provides an excellent demonstration of the principle of the hot wire ammeter for measuring electric current flow.

77365
With aluminum, brass, copper and steel wires
$12.00

CENTRAL SCIENTIFIC COMPANY

SCIENTIFIC INSTRUMENTS — TRADE MARK CENCO REG. U.S. PAT. OFF. — LABORATORY APPARATUS

New York • Boston • CHICAGO • Toronto • Los Angeles

1700 IRVING PARK BOULEVARD, CHICAGO, ILL.